1898MNRAS..58..510M

## *Observations of the Variable Stars* (2100) *U Orionis and* (4896) *T Centauri.* By Colonel E. E. Markwick.

*U Orionis.*—There has been some discussion as to the length of period of this star, which is even now to a certain extent unsettled, although better known than when the data were more limited, for the star has only been observed as a variable since 1885 December 13, when it was first discovered by Mr. Gore. The discoverer made the period 373·47 days (see *Monthly Notices*, vol. l. p. 518). Dr. Chandler in his 2nd Cat. of Variable Stars gave 371 days, with periodic inequality. In the 3rd Cat. this period is changed to 375 days, and I think from what follows this latter period is not far from the truth.

I have observed this star at every period of maximum from 1886 to 1898, except the year 1893, when only one observation was made. The observations have been made usually with a binocular magnifying five times, supplemented by a 2¾-inch refractor. My "date of maximum" is the day on which the star's brightness, when reduced from the comparison stars, was actually greatest. It has not been taken symmetrically as regards the light curve near time of maximum.

The comparison stars and brightness are as follows, the latter being mostly adopted from the *Harvard Photometry* :—

| | | | m. |
|---|---|---|---|
| D.M. | + 20 | 1156 | 6·57 |
| | + 19 | 1126 | 5·85 |
| | + 19 | 1110 | 6·08 |
| | + 20 | 1171 | 8·2 |
| | + 20 | 1168 | 8·6 |
| | + 20 | 1172 | 10·0 |
| $\chi^1$ Orionis | | | 4·65 |
| $\chi^3$ „ (Proctor) = H.P. 1119 | | | 5·08 |

The light curve of this star is very flat near maximum, hence there are bound to be considerable divergencies between the results of different observers. I have therefore taken the mean of my own and all the observations to be found in the summaries of astronomical publications given in the *Journal* of the *B. A. A.* The following table shows my dates of maximum with observed brightness, also the mean of all the observed dates of maximum from 1892, this portion being a revision and continuation of the table at p. 531 of *Monthly Notices*, vol. liv. The last column gives the interval in days between these mean results :—

1898MNRAS..58..510M

| Observed Date of Maximum. | Mag. | Mean of all Observations. | Interval in Days. |
|---|---|---|---|
| 1886 December 16 | 6·12 | ... | ... |
| 1887 ,, 16 | 7·26 | ... | ... |
| 1888 ,, 29 | 5·49 | ... | ... |
| 1889 (no maximum) | ... | ... | ... |
| 1890 January 16 | 6·27 | ... | ... |
| 1891 ,, 9 | 6·3 | ... | ... |
| 1892 ,, 23 | 6·27 | January 31 | 376 |
| 1893 (not observed) | ... | February 10 | 369 |
| 1894 February 8 | 6·07 | ,, 14 | 377 |
| 1895 ,, 24 | 6·08 | ,, 26 | 386 |
| 1896 March 19 | 6·27 | March 18 | 360 |
| 1897 ,, 11 | 5·61 | ,, 13 | 384 |
| 1898 ,, 31 | 6·33 | April 1 | ... |
| | | Mean ... ... | 375·3 |

Also, if we take the interval between two well-determined and most widely separated maxima, and divide by the number of periods elapsed, we get exactly the same result again. Thus:—

| | | Julian. |
|---|---|---|
| 1886 December 12 | | 241,0253 |
| 1898 April 1 | | 241,4381 |
| Difference | ... | 4128 |
| Dividing by 11 | ... | 375·3 |

It seems very probable, therefore, that at present we cannot better this.

The following table shows the comparison of observation and computation based on this period of 375·3 days. It will be observed that the residuals are fairly small except for 1894, 1896, and 1897, in each of which years moonlight was present and probably affected determinations of maximum brightness:—

| | Maximum. | | |
|---|---|---|---|
| Year. | Computed. | Observed. | O–C |
| 1886 | 0252 | 0253 | +1 |
| 1887 | 0628 | 0626 | −2 |
| 1888 | 1003 | 1001 | −2 |
| 1889 | 1378 | 1377 | −1 |
| 1891 | 1754 | 1752 | −2 |
| 1892 | 2129 | 2129 | 0 |
| 1893 | 2504 | 2505 | +1 |
| 1894 | 2879 | 2874 | −5 |
| 1895 | 3255 | 3251 | −4 |
| 1896 | 3630 | 3637 | +7 |
| 1897 | 4005 | 3997 | −8 |
| 1898 | 4381 | 4381 | 0 |

1898MNRAS..58..512M

The only thing that militates against this period is the fact that it does not fall in so well with the ancient dates referred to by Chandler in the *Astronomical Journal*, No. 233, p. 133, as when the period 373·47 days is used. The omission of the star from the observations of Lalande, Bessel, &c., would imply that at those dates it was probably in its fainter stages of brightness. Using a uniform period of 375·3 days, the following shows the distance in time each observation of neighbouring stars was before or after maximum :—

| No. | Authority which failed to observe the Star. | Date of Observation of Vicinity. | Difference in Days from Computed Maximum. |
|---|---|---|---|
| 1 | Lalande | 1797 February 17 | 152 before |
| 2 | Bessel | 1826 March 3 | 56 „ |
| 3 | Markree Observatory | 1850 December 30 | 5 after |
| 4 | Schönfeld | 1853 November 6 | 79 before |
| 5 | Markree | 1854 „ 24 | 71 „ |
| 6 | Schönfeld | 1855 February 18 | 15 after |
| 7 | Krüger | 1857 „ 9 | 14 before |

In the case of 3, 6, and 7, supposing the period of 375·3 days correct, then the star was not far from maximum at these dates, and probably not below 7 m. Hence it is difficult to say why the star was missed ; yet at the same time too much stress must not be laid upon negative evidence. In the other four cases the star was sufficiently far from maximum to account for its being missed.

Plate 7*a* shows the observed brightness for eleven seasons, based on my own determinations alone.

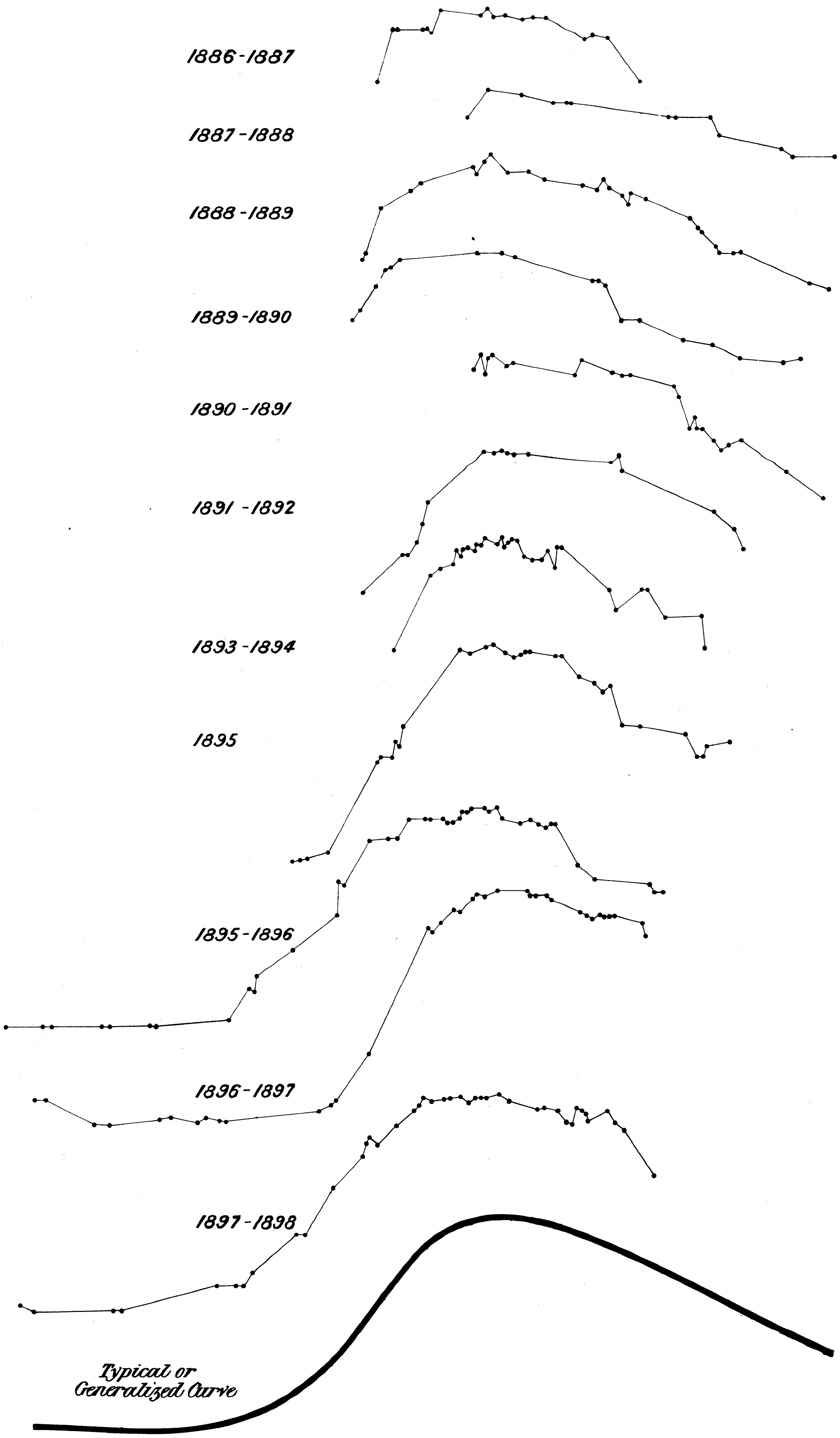
These amount altogether to 307 in number.

The proportion adopted between length representing time (abscissa) and length representing brightness (ordinate) is ten days = 1 magnitude.

Many of the apparent irregularities or departures from a mean curve thus revealed are doubtless due to errors of observation from the various causes which constantly hamper the observer of variable stars. Apart from these, however, some of the fluctuations noted I am convinced are real. For example, in nearly all the curves just after the maximum there is a drop, and then a small recovery, which probably actually occurs. Mr. Peek shows a similar feature in his observations of *S Ursæ Majoris* (Variable Star Notes, No. 3).

I have added a typical or generalised curve, which is a rough mean of all the others, to give a general idea of the star's variation, but I am no believer in smoothed curves, and am confident that in nature gradual increase or decrease in light is subject to certain minor irregularities or fluctuations, which, however, cannot always be easily detected, owing to their minuteness. I do not see any more reason for the curve of light variation being smooth than that of the waxing and waning of sun spots.

1898MNRAS..58..512M



OBSERVATIONS OF U ORIONIS.

1898MNRAS..58..513M

*T Centauri.*—This star, the variability of which was first detected by me at Gibraltar in 1894, has been observed as frequently as possible since. Mr. Roberts has investigated the period (see *Monthly Notices*, vol. lvi. pp. 347 and 500) and shape of the light curve, and from what follows I do not think that his period of 91·5 days can be improved upon.

My observations were made in the same way as those of *U Orionis.* Comparison stars, with brightness :—

| | | |
|---|---|---|
| L 5649 | 7·0 m. | |
| 244 (U.A.) Centauri | 7·0 | |
| 237 Centauri | 6·7 | |
| 241 {L 5613<br>L 5615} Centauri | 6·8 | |
| 286 Centauri | 6·0 | |
| 267 Centauri | 5·8 | |
| 287 Centauri | 6·6 | |
| 233 Centauri | 6·8 (var.) | |
| A | 7·4 | These two stars are s.p. L 5649 at a little greater distance than that separating T from L 5649. |
| B | 7·8 | |
| C | 10 | R.A. 13$^{h}$ 34$^{m}$·6, Dec. −33° 7′ (1875), 8·8 in C.D.M. |
| D | 10·2 | R.A. 13$^{h}$ 34$^{m}$, Dec. −33° 0′, 8·4 in C.D.M. |

The observations of maxima, together with the deduced period, are shown in the following table :—

| | Mag. | Interval. | Corresponding Length of One Period. |
|---|---|---|---|
| 1894 May 25 | 6·25 | | |
| | | 379 | 94·7 |
| 1895 June 8 | 5·3 | | |
| | | 376 | 94·0 |
| 1896 June 18 | 6·4 | | |
| | | 348 | 87·0 |
| 1897 June 1 | 6·17 | | |
| | | 367 | 91·7 |
| 1898 June 3 | 6·6 | | |
| | Mean | ... | ... 91·85 |

Also if we take the interval from the first to the last of these determinations we get 1,470 days, corresponding to a period of 91·9 days.

The observations of minima, which, however, are not so definite as those of maxima, are as follows :—

| | | Interval. | Corresponding Length of One Period. |
|---|---|---|---|
| 1894 July 24 | <8·5 | | |
| | | 276 | 92·0 |
| 1895 April 26 | 10·0 | | |
| | | 370 | 92·5 |
| 1896 April 30 | 9·9 | | |
| | | 718 | 89·8 |
| 1898 April 18 | 9·2 | | |
| | Mean | ... | ... 91·4 |

1898MNRAS..58..513M

Also from the first to the last of these dates is 1,364 days, corresponding to fifteen periods of 90·9 days each.

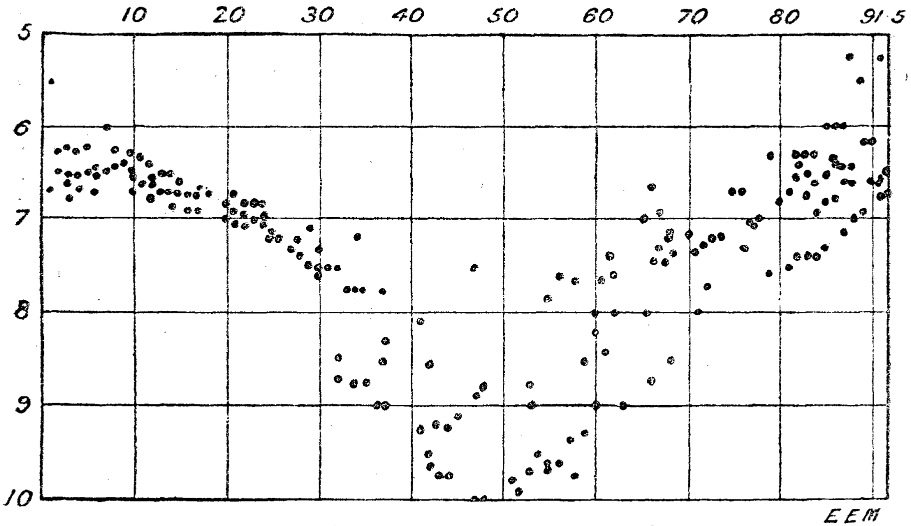
The mean of these four determinations is 91·51 days.

With the adopted period of 91·5 days the residuals come out as follows:—

| Year. | Maximum (Julian). Computed. | Maximum (Julian). Observed. | O – C |
|---|---|---|---|
| 1894 | 2988 | 2974 | – 14 |
| 1895 | 3354 | 3353 | – 1 |
| 1896 | 3720 | 3729 | + 9 |
| 1897 | 4080 | 4077 | – 3 |
| 1898 | 4446 | 4444 | – 2 |

There are but few observations of this star to hand, as it can only be reached from the extreme south of Europe. Mr. Tebbutt observed a maximum on 1896 March 8. This is only one day before the computed time.

Another maximum was observed and recorded in *A. J.*, 49, as on 1897 May 29. This is six days before computation.



Observations of *T Centauri*, 1894–98.

Based on the 91·5-day period all the observations of my own, in No. 203, have been plotted according to phase, *i.e.* to the length of time elapsed from next preceding maximum. The general shape of the light curve is at once apparent, the minimum occurring some forty-eight days after maximum, thus practically agreeing with Roberts's result, forty-nine days.

Unless some long-continued and egregious blunders in determination of brightness have been made, it is plain that the intrinsic brightness varies in different periods, and to a considerable extent. One can trace two, if not more, lines in the ascending branch. Hence I do not think the light curve is ever so smooth

1898MNRAS..58..513M

and regular as that given by Roberts at p. 350 of *Monthly Notices*, in the first of the papers previously referred to. The brightness undoubtedly varies in different periods, and I think the general curve is subject to minor irregularities, as in the case of *U Orionis*.

---

## *Observations of Nebulæ.* By Herbert A. Howe.

(*Communicated by the Secretaries.*)

The following notes are in continuation of those published in the April, 1898, number of the *Monthly Notices*, and were made in the course of my observations upon nebulæ, during the first six months of 1898. The numbers, as previously, are the current ones of the N.G.C., except those which are enclosed in brackets, which refer to Dreyer's Index Catalogue in vol. li. of the *Memoirs of the R.A.S.* When, instead of a number, the name Swift is given, reference is made to objects recently discovered at the Lowe Observatory, found in lists published from time to time in various periodicals, chiefly in the *Monthly Notices.*

As the positions of so many of the nebulæ in my working list are erroneous, because of the inaccurate places given by the discoverers, I have striven not to add new errors by mistakes of my own, and have therefore determined the position of each comparison star twice, once by means of the circles of the instrument, and a sidereal watch, and a second time by connecting it with some catalogue star by chronographic and micrometric measures. There are two checks against gross errors in the micrometric measurements between each nebula and its comparison star. These are, firstly, independent estimates of $\Delta\alpha$ and $\Delta\delta$ by the help of the known intervals between the micrometer wires, and, secondly, sketches of the field of view. In a few cases a larger telescope, or a keener eye, may be needed to settle doubtful points. All positions are referred to the mean equinox of 1900·0.

The new Bruce micrometer, to which reference was made in my former communication, has now been in use for six months, and has proven itself to be a most admirable instrument. It has a set of eleven wires in R.A., and nine in declination, the latter spanning a space of 30′; the sets can be illuminated separately or simultaneously, with any desired intensity. The micrometer screw has movable heads, so that three bisections can be made before the readings are taken. The box can also be revolved just 90°, without reading the position-circle.

(195) and (196). These two nebulæ were not at all difficult to see, and I found no others in their neighbourhood. Hence I assume the ones which I observed to be those found by